

**Introduction to
Information &
Communication
Technologies
CL-1000**

Lab 09
Introduction to LaTeX

National University of Computer & Emerging Sciences – NUCES – Karachi



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1. What is LaTeX?

LATEX (pronounced *LAY-tek* or *LAH-tek*) is a tool used to create professional-looking documents. It is based on the WYSIWYM (what you see is what you mean) idea, meaning you only have focus on the contents of your document and the computer will take care of the formatting. Instead of spacing out text on a page to control formatting, as with Microsoft Word, users can enter plain text and let LaTeX take care of the rest.

2. Why Learn LaTeX?

LaTeX is widely used for scientific documents, books, and various types of publishing. It produces well-formatted documents and simplifies complex typesetting tasks like inputting mathematics, creating tables of contents, referencing, and maintaining a consistent layout. With numerous open-source packages available, LaTeX offers extensive possibilities, including adding footnotes, drawing schematics, and creating tables.

LaTeX separates content from style, allowing easy appearance changes and standardized document templates. This enables consistent layouts for various documents, with templates available for everything from scientific journals to CVs.

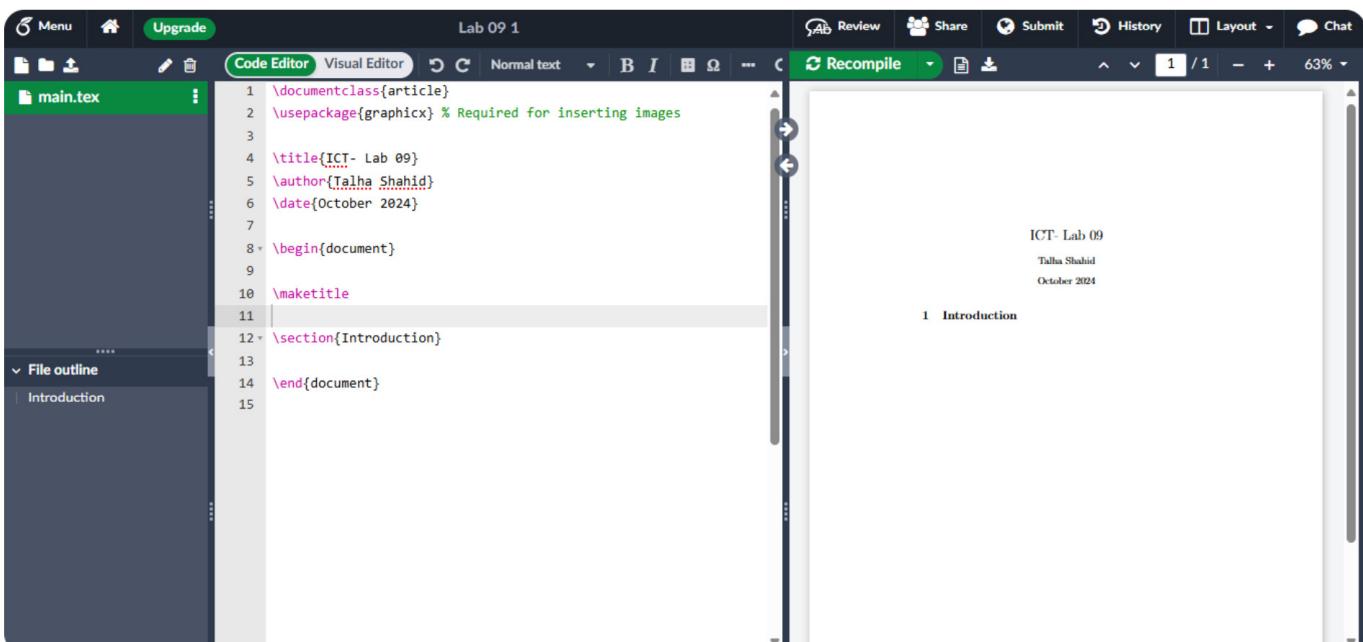
3. Writing your first piece of LaTeX (Overleaf)

3.1 What is Overleaf?

Overleaf is a collaborative cloud-based LaTeX editor used for writing, editing and publishing scientific documents. It partners with a wide range of scientific publishers to provide official journal LaTeX templates, and direct submission links.

3.2 Writing Latex in Overleaf?

The first step is to create a new LaTeX project. You can start a new project in Overleaf. Let's start with the simplest working example:



The screenshot shows the Overleaf LaTeX editor interface. On the left, the 'Code Editor' tab is active, displaying the following LaTeX code:

```
\documentclass{article}
\usepackage{graphicx} % Required for inserting images
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}
\maketitle
\section{Introduction}
\end{document}
```

On the right, the 'Recompile' tab is active, showing the generated PDF output:

ICT- Lab 09
Talha Shahid
October 2024

1 Introduction

```
\documentclass{article}
\usepackage{graphicx} % Required for inserting images

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\section{Introduction}

\end{document}
```

3.2.1 Explanation of the basic LaTeX Code

1. Document Class Declaration:

```
\documentclass{article}
```

This line sets the type of document you're creating. The **article** class is used here, which is suitable for shorter documents like reports, papers, or lab manuals.

2. Including Packages:

```
\usepackage{graphicx} % Required for inserting images
```

The **\usepackage{graphicx}** line imports the **graphicx** package, which allows you to include images in your document. Although no images are used in this example, it's good practice to include the package if you plan to add them later.

3. Setting the Title, Author, and Date:

```
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}
```

- **\title{ICT- Lab 09}** specifies the title of the document.
- **\author{Talha Shahid}** sets the author's name.
- **\date{October 2024}** sets the document date. If you leave it blank as **\date{}**, LaTeX will automatically use the current date.

4. Beginning the Document:

```
\begin{document}
```

This line starts the main content of the document. Anything you want to include in the output must be placed after this command.

5. Generating the Title:

```
\maketitle
```

The `\maketitle` command generates the title section of the document, displaying the title, author, and date set earlier.

6. Adding a Section:

```
\section{Introduction}
```

This command creates a new section titled "**Introduction.**" The section number will be automatically added by LaTeX.

7. Ending the Document:

```
\end{document}
```

This line marks the end of the document. Any content added after this command will be ignored.

To see the result of these changes in the PDF you have to compile the document. To do this in Overleaf, simply hit **Recompile**. (You can also set your project to automatically recompile when you edit your files, by clicking on the small arrow next to the '**Recompile**' button and set '**Auto Compile to 'On.'**)

If you are using a dedicated LaTeX editor such as **TeXmaker** or **TeXworks**, simply hit the **Recompile** button. Consult the programs documentation if you are unsure of where this is.

Now that you have learnt how to add content to our document, the next step is to give it a title. To do this, we must talk briefly about the preamble.

4. The Preamble of a LaTeX Document

In the previous example the text was entered after the `\begin{document}` command. Everything in your `.tex` file before this point is called the **preamble**. In the preamble you define the type of document you are writing, the language you are writing in, the packages you would like to use (more on this later) and several other elements. For instance, a normal document preamble would look like this:

```
\documentclass[12pt, letterpaper]{article}
\usepackage[utf8]{inputenc}
```

Below a detailed description of each line:

```
\documentclass[12pt, letterpaper]{article}
```

As said before, this defines the type of document. Some additional parameters included in the square brackets can be passed to the command. These parameters must be comma-separated. In the example, the extra parameters set the font size (**12pt**) and the paper size (**letterpaper**). Of course, other font sizes (**9pt**, **11pt**, **12pt**) can be used, but if none is specified, the default size is **10pt**. As for the paper size other possible values are **a4paper** and **legalpaper**.

```
\usepackage[utf8]{inputenc}
```

This is the encoding for the document. It can be omitted or changed to another encoding but utf-8 is recommended. Unless you specifically need another encoding, or if you are unsure about it, add this line to the preamble.

4. Adding Title, Author and Date

To add a **title**, **author** and **date** to our document, you must add three lines to the preamble (NOT the main body of the document). These lines are:

```
\title{ICT- Lab 09}
```

This is the title.

```
\author{Talha Shahid}
```

Here you put the name of the Author(s).

```
\date{February 2014}
```

```
\date{October 2024}
```

You can enter the date manually or use the command **\today** so the date will be updated automatically at the time you compile your document

With these lines added, your preamble should look something like this:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\end{document}
```

Now that you have given your document a **title**, **author** and **date**, you can print this information on the document with the `\maketitle` command. This should be included in the body of the document at the place you want the title to be printed.

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5. Adding Comments

As with any code you are writing, it can often be useful to include comments. Comments are pieces of text you can include in the document which will not be printed, and will not affect the document in any way. They are useful for organizing your work, taking notes, or commenting out lines/**sections** when debugging. To make a comment in LaTeX, simply write a % symbol at the beginning of the line as shown below:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
```

```
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}
```

```
\begin{document}
```

```
\maketitle
```

We have now added a title, author and date to our first \LaTeX{} document!
% This line here is a comment. It will not be printed in the document.

```
\end{document}
```

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We have now added a title, author and date to our first L^AT_EX document!

6. Bold, Italics and Underlining

We will now look at some simple text formatting commands.

1. **Bold:** Bold text in LaTeX is written with the `\textbf{...}` command.
2. **Italics:** Italicised text in LaTeX is written with the `\textit{...}` command.
3. **Underline:** Underlined text in LaTeX is written with the `\underline{...}` command.

An example of each of these in action is shown below:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

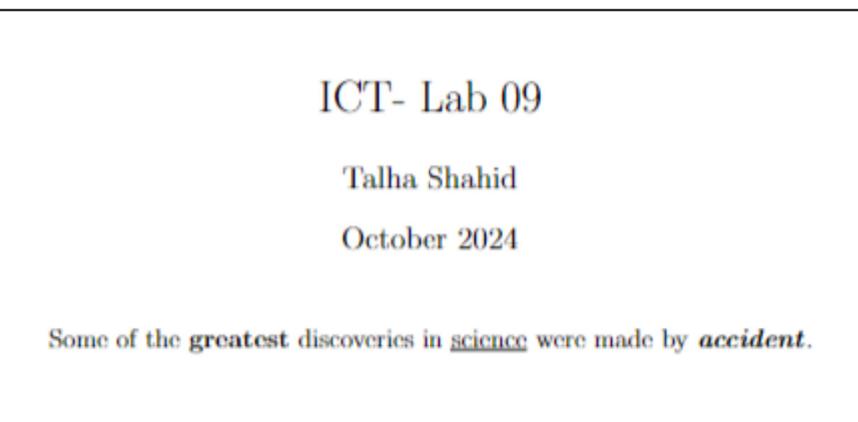
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

Some of the \textbf{greatest} discoveries in \underline{science}
were made by \textbf{\textit{accident}}.

\end{document}
```



Another very useful command is the `\emph{...}` command. What the `\emph` command actually does with its argument depends on the context - inside normal text the emphasized text is italicized, but this behaviour is reversed if used inside an italicized text- see example below:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}
```

```

\begin{document}

\maketitle

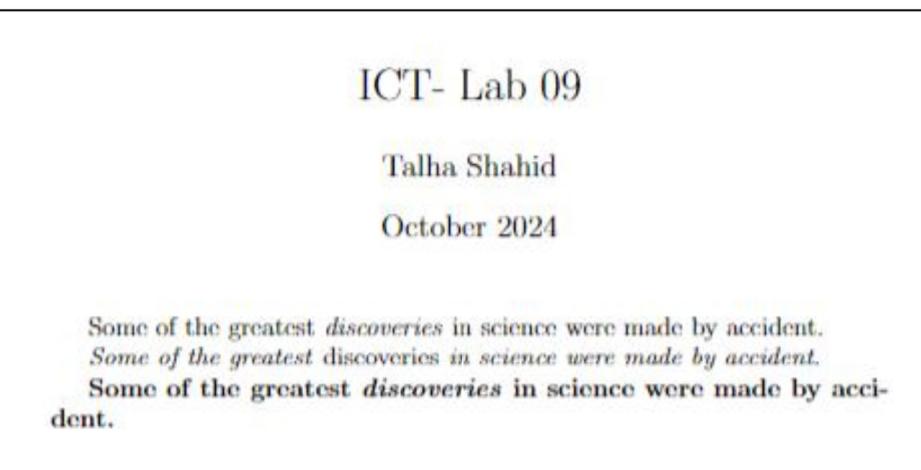
Some of the greatest \emph{discoveries} in science
were made by accident.

\textit{Some of the greatest \emph{discoveries} in science
were made by accident.}

\textbf{Some of the greatest \emph{discoveries} in science
were made by accident.}

\end{document}

```



8. Adding images

We will now look at how to add images to a LaTeX document. On Overleaf, you will first have to upload the images.

Below is an example on how to include a picture:

```

\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
\usepackage{graphicx}
\graphicspath{{images/}} % Folder name should match the actual path

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

```

LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

```
\includegraphics[width=\textwidth]{image} % Specify the correct file extension and scaling
```

There's a picture of a Laptop above.

```
\end{document}
```

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LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.



There's a picture of a Laptop above.

Lab 09.1

Code Editor Visual Editor Review Share Submit History Layout Chat

Menu Upgrade

images image.jpg main.tex

File outline

We can't find any sections or subsections in this file. Find out more about the file outline

```
1 \documentclass[12pt, letterpaper, twoside]{article}
2 \usepackage[utf8]{inputenc}
3 \usepackage{graphicx}
4 \graphicspath{{images/}} % Folder name should match the actual path
5
6 \title{ICT- Lab 09}
7 \author{Talha Shahid}
8 \date{October 2024}
9
10 \begin{document}
11
12 \maketitle
13
14 LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.
15
16 \includegraphics[width=\textwidth]{image} % Specify the correct file extension and scaling
17
18 There's a picture of a Laptop above.
19
20 \end{document}
```

Recompile

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LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.



There's a picture of a Laptop above.

LaTeX can't manage images by itself, so you will need to use a package. Packages can be used to change the default look of your LaTeX document, or to allow more functionalities. In this case, you need to include an image in our document, so you should use the `graphicx` package. This package gives new commands, `\includegraphics{...}` and `\graphicspath{...}`. To use the `graphicx` package, include the following line in your preamble:

```
\usepackage{graphicx}
```

The command `\graphicspath{ images/}` tells LaTeX that the images are kept in a folder named `images` under the current directory.

In the line `\includegraphics[width=\textwidth]{image}`, the `width=\textwidth` option scales the image to match the width of the text area on the page. This ensures that the image will span the full width of the main body of the document, fitting neatly within the margins.

The `{image}` command is the one that actually included the image in the document. Here `universe` is the name of the file containing the image without the extension, then `image.jpg` becomes `image`. The file name of the image should not contain white spaces nor multiple dots.

Note: *The file extension is allowed to be included, but it's a good idea to omit it. If the file extension is omitted it will prompt LaTeX to search for all the supported formats. It is also usually recommended to use lowercase letters for the file extension when uploading image files. For more details see the section about generating high resolution and low-resolution images.*

9. Captions, labels and references

Images can be captioned, labelled and referenced by means of the figure environment as shown below:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
\usepackage{graphicx}
\graphicspath{{images/}} % Folder name should match the actual path

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}
```

```
\maketitle
```

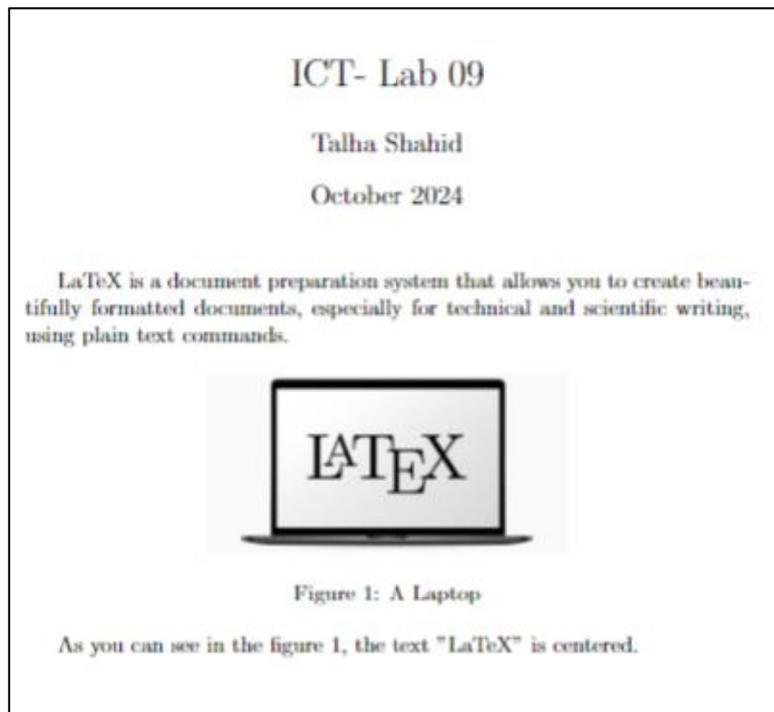
LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

```
\begin{figure}[h]
    \centering
    \includegraphics[width=0.5\textwidth]{image.jpg} % Specify the correct
file extension and scaling
    \caption{A Laptop}
```

```
\label{fig:laptop}  
\end{figure}
```

As you can see in the figure `\ref{fig:laptop}`, the text "LaTeX" is centered.

```
\end{document}
```



There are three important commands in the example:

1. `\caption{A Laptop}`: As you may expect this command sets the caption for the figure. If you create a list of figures this caption will be used there. You can place it above or below the figure.
2. `\label{fig:laptop}`: If you need to refer the image within your document, set a label with this command. The label will number the image, and combined with the next command will allow you to reference it.
3. `\ref{fig:laptop}`: This code will be substituted by the number corresponding to the referenced figure.

When placing images in a LaTeX document, we should always put them inside a **figure** environment or similar so that LaTeX will position the image in a way that fits in with the rest of your text.

Note: If you are using captions and references on your own computer, you will have to compile the document twice for the references to work. Overleaf will do this for you automatically.'

10. Creating Lists

Lists are very simple to create in LaTeX. You can create lists using different list environments. Environments are sections of our document that you want to present in a different way to the rest of the document. They start with a `\begin{...}` command and end with an `\end{...}` command.

There are two main different types of lists, ordered lists and unordered lists. Each will use a different environment.

10.1 Unordered lists

Unordered lists are produced by the `itemize` environment. Each entry must be preceded by the control sequence `\item` as shown below:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

LaTeX is a document preparation system that allows you to create beautifully
formatted documents, especially for technical and scientific writing, using
plain text commands.

\begin{itemize}

\item The individual entries are indicated with a black dot, a so-called
bullet.
\item The text in the entries may be of any length.

\end{itemize}

\end{document}
```

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- The individual entries are indicated with a black dot, a so-called bullet.
- The text in the entries may be of any length.

By default, the individual entries are indicated with a black dot, so-called bullet. The text in the entries may be of any length.

10.2 Ordered lists

Ordered list have the same syntax inside a different environment. We make ordered lists using the `enumerate` environment:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

\begin{itemize}
    \item The individual entries are indicated with a black dot, a so-called bullet.
    \item The text in the entries may be of any length.
\end{itemize}

\begin{enumerate}
    \item This is the first entry in our list
    \item The list numbers increase with each entry we add.
\end{enumerate}

\end{document}
```

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LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

- The individual entries are indicated with a black dot, a so-called bullet.
 - The text in the entries may be of any length.
1. This is the first entry in our list.
 2. The list numbers increase with each entry we add.

As with unordered lists, each entry must be preceded by the control sequence `\item`, which will automatically generate the number labelling the item. The enumerate labels consists of sequential numbers starting at one.

11. Adding Maths

One of the main advantages of LaTeX is the ease at which mathematical expressions can be written. LaTeX allows two writing modes for mathematical expressions: the inline mode and the display mode. The first one is used to write formulas that are part of a text. The second one is used to write expressions that are not part of a text or paragraph, and are therefore put on separate lines. Let's see an example of the inline mode:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
```

```
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}
```

```
\begin{document}
```

```
\maketitle
```

LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

```
\vspace{\baselineskip} % for space between paragraphs
```

In physics, the mass-energy equivalence is stated by the equation $E=mc^2$, discovered in 1905 by Albert Einstein.

```
\end{document}
```

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LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

In physics, the mass-energy equivalence is stated by the equation $E = mc^2$, discovered in 1905 by Albert Einstein.

To put your equations in inline mode use one of these delimiters: `\(... \)`, `$... $` or `\begin{math} ... \end{math}`. They all work and the choice is a matter of taste. The displayed mode has two versions: numbered and unnumbered.

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
```

```
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}
```

```
\begin{document}
```

```
\maketitle
```

LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

```
\vspace{\baselineskip} % for sapace between paragraphs
```

In physics, the mass-energy equivalence is stated by the equation $E=mc^2$, discovered in 1905 by Albert Einstein.

```
\vspace{\baselineskip}
```

The mass-energy equivalence is described by the famous equation `\[E=mc^2\]` discovered in 1905 by Albert Einstein. In natural units (`\$c = 1\$`), the formula expresses the identity

```
\begin{equation}
E=m
\end{equation}
```

```
\end{document}
```

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LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

In physics, the mass-energy equivalence is stated by the equation $E = mc^2$, discovered in 1905 by Albert Einstein.

The mass-energy equivalence is described by the famous equation

$$E = mc^2$$

discovered in 1905 by Albert Einstein. In natural units ($c = 1$), the formula expresses the identity

$$E = m \quad (1)$$

To print your equations in display mode use one of these delimiters: `\[... \]`, `\begin{displaymath} ... \end{displaymath}` or `\begin{equation} ... \end{equation}`. `$$... $$` is discouraged as it can give inconsistent spacing, and may not work well with some math packages.

Important Note: `equation*` environment is provided by an external package, consult the `amsmath` article.

Many math mode commands require the `amsmath` package, so be sure to include it when writing math. An example is shown below of some basic math mode commands.

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
```

```
\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}
```

```
\begin{document}
```

```
\maketitle
```

LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

```
\vspace{\baselineskip} % for sapace between paragraphs
```

Subscripts in math mode are written as `a_b` and superscripts are written as `a^b`. These can be combined and nested to write expressions such as

```
 $$T^{i_1 i_2 \dots i_p}_{\quad j_1 j_2 \dots j_q} = T(x^{i_1}, \dots, x^{i_p}, e_{j_1}, \dots, e_{j_q})$$
```

We write integrals using `\int` and fractions using `\frac{a}{b}`. Limits are placed on integrals using superscripts and subscripts:

```
 $$\int_0^1 \frac{1}{e^x} = \frac{e-1}{e}$$
```

Lower case Greek letters are written as `\omega` `\delta` etc. while upper case Greek letters are written as `\Omega` `\Delta`.

Mathematical operators are prefixed with a backslash as `\sin(\beta)`, `\cos(\alpha)`, `\log(x)` etc.

```
\end{document}
```

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LaTeX is a document preparation system that allows you to create beautifully formatted documents, especially for technical and scientific writing, using plain text commands.

Subscripts in math mode are written as a_b and superscripts are written as a^b . These can be combined and nested to write expressions such as

$$T^{i_1 i_2 \dots i_p}_{j_1 j_2 \dots j_q} = T(x^{i_1}, \dots, x^{i_p}, e_{j_1}, \dots, e_{j_q})$$

We write integrals using `\int` and fractions using $\frac{a}{b}$. Limits are placed on integrals using superscripts and subscripts:

$$\int_0^1 \frac{1}{e^x} = \frac{e-1}{e}$$

Lower case Greek letters are written as ω δ etc. while upper case Greek letters are written as Ω Δ .

Mathematical operators are prefixed with a backslash as $\sin(\beta)$, $\cos(\alpha)$, $\log(x)$ etc.

The possibilities with math in LaTeX are endless and it is impossible to list them all here. Be sure to check out our other articles on

- Mathematical expressions
- Subscripts and superscripts
- Brackets and Parentheses
- Fractions and Binomials
- Aligning Equations
- Operators
- Spacing in math mode
- Integrals, sums and limits
- Display style in math mode
- List of Greek letters and math symbols
- Mathematical fonts

12. Basic Formatting

We will now look at how to write abstracts, as well as how to format a LaTeX document into different chapters, sections and paragraphs.

12.1 Abstracts

In scientific documents it's a common practice to include a brief overview of the main subject of the paper. In LaTeX there's the abstract environment for this. The abstract environment will put the text in a special format at the top of your document.

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

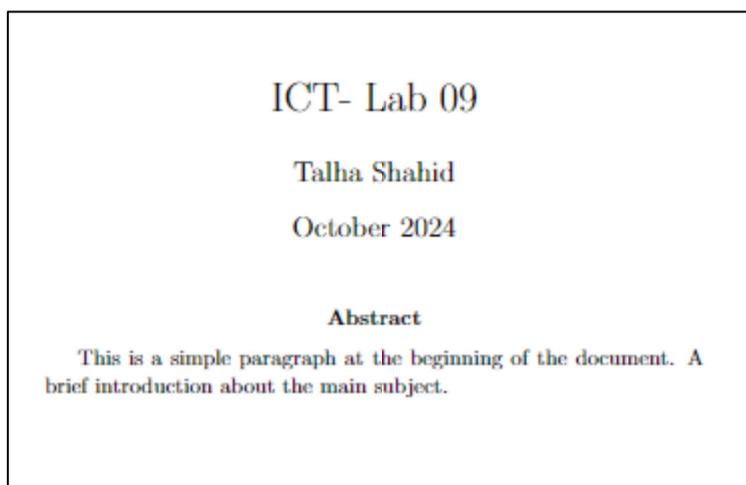
\maketitle

\begin{abstract}

    This is a simple paragraph at the beginning of the document. A brief introduction about the main subject.

\end{abstract}

\end{document}
```



12.2 Paragraphs and newlines

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\begin{abstract}

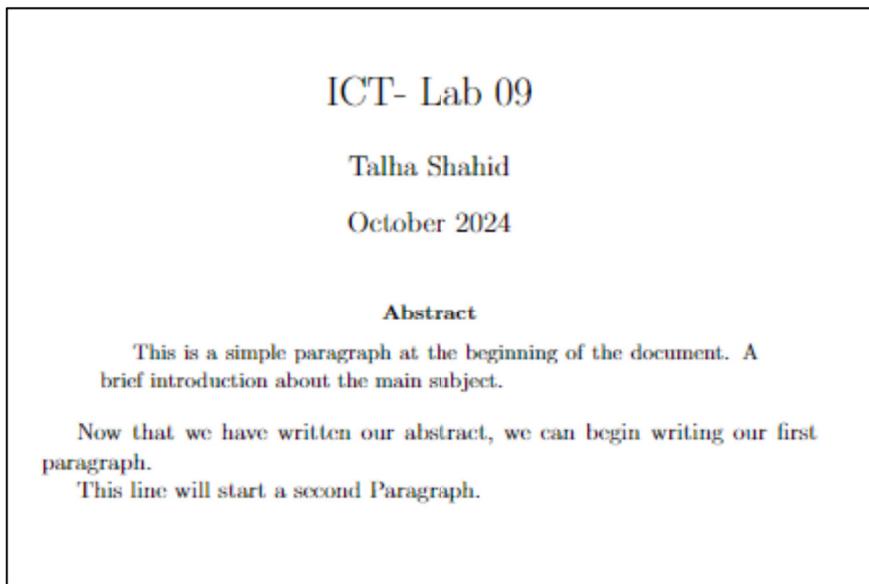
    This is a simple paragraph at the beginning of the document. A brief introduction about the main subject.

\end{abstract}

Now that we have written our abstract, we can begin writing our first paragraph.

This line will start a second Paragraph.

\end{document}
```



12.3 Chapters and Sections

Commands to organize a document vary depending on the document type, the simplest form of organization is the sectioning, available in all formats.

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}
```

```

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\section{First Section}
This is the first section. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales...

\section{Second Section}
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante...

\subsection{First Subsection}
Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales...

\section*{Unnumbered Section}
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem.

\end{document}

```

ICT- Lab 09

Talha Shahid

October 2024

1 First Section

This is the first section. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales...

2 Second Section

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante...

2.1 First Subsection

Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales...

Unnumbered Section

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem.

The command `\section{}` marks the beginning of a new section, inside the braces is set the title. Section numbering is automatic and can be disabled by including an `*` in the section command as `\section*{}`. We can also have `\subsection{}`, and indeed `\subsubsection{}`. The basic levels of depth are listed below:

1. `\part{part}`
2. `\chapter{chapter}`
3. `\section{section}`
4. `\subsection{subsection}`
5. `\subsubsection{subsubsection}`
6. `\paragraph{paragraph}`
7. `\ subparagraph{subparagraph}`

Note that `\part` and `\chapter` are only available in `report` and `book` document **classes**.

13. Creating Tables

Below you can see the simplest working example of a table:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\begin{center}
\begin{tabular}{ c c c }
cell1 & cell2 & cell3 \\
cell4 & cell5 & cell6 \\
cell7 & cell8 & cell9
\end{tabular}
\end{center}

\end{document}
```

cell1	cell2	cell3
cell4	cell5	cell6
cell7	cell8	cell9

The tabular environment is the default LaTeX method to create tables. You must specify a parameter to this environment, in this case `{c c c}`.

This tells LaTeX that there will be three columns and that the text inside each one of them must be centred. You can also use `r` to align the text to the right and `l` for left alignment. The alignment symbol `&` is used to specify the breaks in the table entries.

There must always be one less alignment symbol in each line than the number of columns. To go to the next line of your table, we use the new line command `\backslash`. We wrap the entire table inside the `center` environment so that it will appear in the `center` of the page.

13.1 Adding Borders

The tabular environment is more flexible; you can put separator lines in between each column.

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\begin{center}
\begin{tabular}{ |c|c|c| }
\hline
cell1 & cell2 & cell3 \\
\hline
cell4 & cell5 & cell6 \\
\hline
cell7 & cell8 & cell9 \\
\hline
\end{tabular}
\end{center}

\end{document}
```

cell1	cell2	cell3
cell4	cell5	cell6
cell7	cell8	cell9

You can add borders using the horizontal line command `\hline` and the vertical line parameter

`{|c|c|c|}`: This declares that three columns, separated by a vertical line, are going to be used in the table. The | symbol specifies that these columns should be separated by a vertical line.

`\hline`: This will insert a horizontal line. We have included horizontal lines at the top and bottom of the table here. There is no restriction on the number of times you can use `\hline`.

Below you can see a second example:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}

\maketitle

\begin{center}
\begin{tabular}{||c c c c||}
\hline
Col1 & Col2 & Col3 & Col4 \\ [0.5ex]
\hline\hline
1 & 6 & 87837 & 787 \\
\hline
2 & 7 & 78 & 5415 \\
\hline
3 & 545 & 778 & 7507 \\
\hline
4 & 545 & 18744 & 7560 \\
\hline
5 & 88 & 788 & 6344 \\ [1ex]
\hline
\end{tabular}
\end{center}

\end{document}
```

Col1	Col2	Col3	Col4
1	6	87837	787
2	7	78	5415
3	545	778	7507
4	545	18744	7560
5	88	788	6344

Creating tables in LaTeX can be a bit tricky sometimes, so you may want to use the [TablesGenerator.com](https://www.tablesgenerator.com) online tool to export LaTeX code for tabulars. The File > Paste table data option lets you copy and paste data from spreadsheet applications.

13.2 Captions, Labels and References

You can caption and reference tables in much the same way as images. The only difference is that instead of the figure environment, you use the table environment.

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}
\maketitle

Table \ref{table:data} is an example of referenced \LaTeX{} elements.

\begin{table}[h!]
\centering
\begin{tabular}{||c c c c||}
\hline
Col1 & Col2 & Col3 & Col4 \\ \hline
1 & 6 & 87837 & 787 \\
2 & 7 & 78 & 5415 \\
3 & 545 & 778 & 7507 \\
4 & 545 & 18744 & 7560 \\
5 & 88 & 788 & 6344 \\ \hline
\end{tabular}
\caption{Table to test captions and labels}
\label{table:data}

```

```
\end{table}

\end{document}
```

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Table 1 is an example of referenced L^AT_EX elements.

Col1	Col2	Col3	Col4
1	6	87837	787
2	7	78	5415
3	545	778	7507
4	545	18744	7560
5	88	788	6344

Table 1: Table to test captions and labels

Note: If you are using captions and references on your own computer, you will have to compile the document twice for the references to work. Overleaf will do this for you automatically.

14. Adding a Table of Contents

To create the table of contents is straightforward, the command **\tableofcontents** does all the work for you:

```
\documentclass[12pt, letterpaper, twoside]{article}
\usepackage[utf8]{inputenc}

\title{ICT- Lab 09}
\author{Talha Shahid}
\date{October 2024}

\begin{document}
\maketitle

\tableofcontents

\section{Introduction}
This is the first section. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Paesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales...

\addcontentsline{toc}{section}{Unnumbered Section}
\section*{Unnumbered Section}
```

```
    Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisissem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi necante...
```

```
\section{Second Section}
```

```
    Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisissem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi necante...
```

```
\end{document}
```

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Contents

1 Introduction	1
Unnumbered Section	1
2 Second Section	1

1 Introduction

This is the first section. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisissem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi necante. Donec ullamcorper, felis non sodales...

Unnumbered Section

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisissem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi necante...

2 Second Section

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisissem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi necante...

1

Sections, subsections and chapters are automatically included in the table of contents. To manually add entries, for example when you want an unnumbered section, use the command \addcontentsline as shown in the example.